Chapter 6

Electricity

Electricity is so much a part of everyone's lives that it is hard to imagine being without it. Yet it has only been since 1882 that electricity has become a reality to us. Before electricity, we had to use kerosene lamps to see at night. Food was cooled by ice transported from cold climates. Rooms were warmed by wood-burning stoves.

Thanks to Thomas Edison and other scientists, everyone can now use electricity to do these things. Today, electricity is so commonplace, most people rarely stop to think about it.

What is electricity?

Electricity is electrons in motion. To understand what is meant by this, look again at the diagram of the carbon atom shown on page 19. The electrons surrounding the nucleus of an atom are only loosely held in place. This makes it easy for them to fall out of orbit.

When this happens, an electron becomes a *free electron*. Practically everything around us contains free electrons. Typically, free electrons move about randomly. However when force or *voltage* is applied, the free electrons move in an orderly fashion. This movement of free electrons under the influence of force is known as *electrical current*.

Electrical current will flow as long as voltage is applied. This is how batteries and power plant generators work. It's also what happens to lightning during a thunderstorm.

The History of Electricity

People have known about electricity since before the time of the Ancient Greeks. But scientists didn't set out to make electricity work for them until the turn of the 19th century.

One of the first uses was in arc lighting. Invented by Sir Humphry Davy in 1808, arc lights were used outdoors in place of gas lights. They were, however, too hot and too big to bring indoors. They were also expensive.

It took the great inventor Thomas Edison to figure out how to bring lighting indoors. In 1878, the 31-year-old Edison announced to the world that he was going to tackle the problem of producing light using electricity. Nearly everyone was convinced that the man who had already invented wax paper, the mimeograph machine, the stock ticker and the phonograph could accomplish this feat of wizardry.

One year and thousands of experiments later, Edison achieved his goal. Using scorched cotton sewing thread and electricity, Edison produced 40 hours of continuous light. The light bulb was born.

Other ideas of Edison's actually brought electricity into our homes. Over a three year period, he created electrical switches, sockets, fuses, meters, and transmission and distribution lines. He also developed an electrical generating system. Generators use mechanical energy to produce electricity.

On September 4, 1882, Edison and his colleagues generated electrical current from New York City's Pearl Street Station into 85 homes and businesses. Edison noted at the time, "I have accomplished all that I promised."

After Edison's breakthrough, the use of electricity grew quickly in America. Today electricity is so central to everyday life that most people take it for granted.

How Electricity Is Produced Today

Steam Power

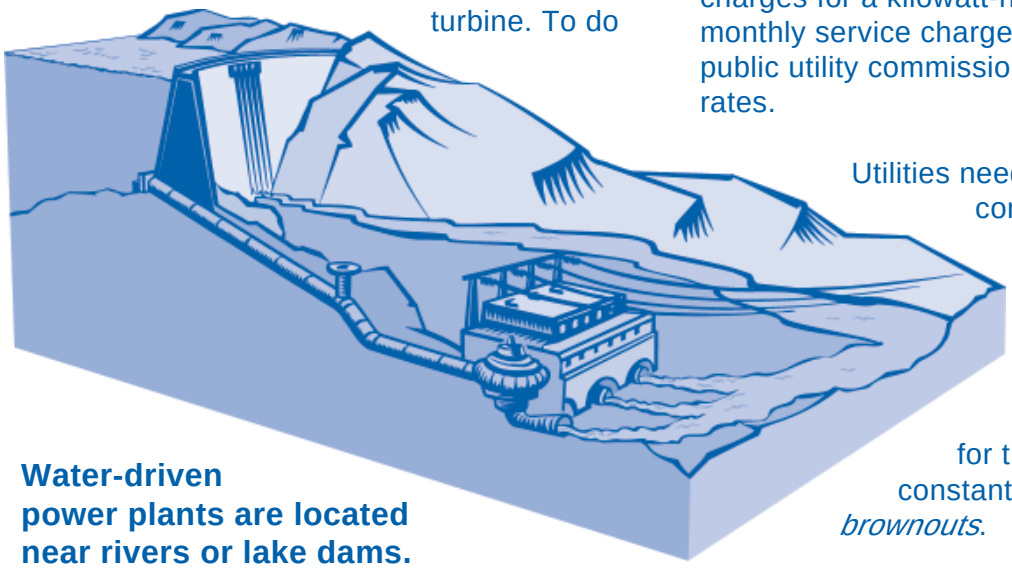
Today, most of the electricity used is produced by power plants. The most common method uses steam. Coal, gas, oil or nuclear fuel is used to produce heat to make steam.

To view how this process works, turn to the diagram of a nuclear reactor on pages 20 and 21. Steam is piped to the turbine. The turbine's shaft is connected to a huge magnet in the generator. As steam turns the turbine, the magnet spins inside a coil of wire. This spinning action creates a force which causes the electrons on the metal wires to flow. Thus, electrical current is produced.

From here, the electricity flows to the power plant transformer where it is "stepped up." After leaving the power plant, the electricity flows to substations of local utility companies. Here, the voltage is "stepped down" to a usable level. Electricity then flows through distribution lines from the substations to customers in the residential, industrial and commercial sectors.

Water Power

Water power also can be used to generate electricity. Instead of steam, moving water is used to turn the turbine. To do this, water in great force is needed. This is why water-driven plants are located near rivers or lake dams. Think of Niagara Falls. It is the ideal locale for a *hydroelectric plant*.



Water-driven power plants are located near rivers or lake dams.

Hydroelectric plants have been in existence since before 1900. In 1900, 57 percent of the electricity produced in this country came from water power. Today, hydroelectric power accounts for just three percent of the electricity generated in South Carolina. This is mostly due to the fact that lakes and rivers are currently being used to their full capacity.

Utilities and Their Customers

How Electricity Is Sold

In most cases, South Carolina's electricity is generated by power plants owned by the utilities. The utilities then sell the electricity to their customers. The electricity flows to a home or building through a distribution line and enters the facility at the meter point.

Meters measure the amount of electricity used in kilowatt-hours. One kilowatt-hour is about the amount of energy needed to run an iron for one hour.

The cost of the electricity is determined by multiplying the number of kilowatt-hours used each month by the cost the utility company charges for a kilowatt-hour of electricity, plus a monthly service charge. Federal, state and local public utility commissions determine these rates.

Utilities need to anticipate consumers' demand for electricity. During hot summer days, everyone wants the air conditioner on high. Were the electric companies not prepared for this, there would be constant power shortages or *brownouts*.

Anticipating demand is important because electricity cannot be stored. To meet peak needs, utilities must generate all of the electricity they can and shift demand for electricity to off-peak times (late at night) or incorporate energy saving measures. Sometimes they even have to purchase electricity from other utilities.

Load Management

To be prepared, modern utilities practice *load management*. Load management is the balancing of electricity supply with consumer demand.

The goal of load management is to even out the peaks and valleys of electricity use. Peak use usually occurs on hot summer afternoons in South Carolina. They also include winter mornings and evenings when lights and furnaces are on. Off-peak times occur on weekends and at night. This is when most offices, factories and schools are closed.

Several load management techniques are used. Direct control allows the utilities to switch the flow of electricity on or off. During peak load times, customers allow the utility to temporarily shut down electricity to a customer's central air conditioning unit or electric water heater. When the peak demand is over, power is returned. Customers who allow the utilities to add switches to their meters receive monthly credits on their utility bills.

Time of use pricing rewards customers who use electricity during off-peak hours. Conversely, customers who use electricity during peak hours may be charged higher rates. This also is a voluntary program, used by industries who can shift load.

Some utilities also make use of pumped-storage power plants to help with load management. These facilities produce electricity during peak times. The diagram on the next page shows how a pumped-storage plant works.

Pumped storage plants actually use more energy than they generate. Even so, they are cost-effective. This is because other ways of meeting peak electricity demands are even more expensive.

Electricity In South Carolina

South Carolina's use of electricity continues to increase. During the last 20 years, the amount of electricity produced and used in the state has more than tripled.

As the state's economy has grown, so has its need for electricity. South Carolina power plants generate about 90 billion kilowatt hours of electricity each year. About 57 percent of this electricity comes from nuclear power plants. Coal-fired plants produce almost all of the remaining electricity. Just under four percent of our electricity comes from plants powered by petroleum, natural gas or water.

South Carolina's electricity is provided by private investor-owned utilities, city-owned utilities, rural electric cooperatives and a state-owned utility.

The Investor-owned Utilities

Four investor-owned utilities serve South Carolina: S.C. Electric and Gas (SCE&G), Duke Power, Progress Energy and Lockhart Power Company. These utilities each have an assigned service territory and a legal obligation to serve all the consumers in their territories, and are regulated by the S.C. Public Service Commission and federal regulations. Each investor-owned utility is owned by thousands of investors who have stock in the company.

SCE&G has its headquarters in Columbia and is an important supplier of electricity in the state. It maintains 3,440 miles of transmission lines and 15,713 miles of distribution lines which serve more than 531,000 customers in the Midlands and Low Country. SCE&G generates and sells about 17 billion kilowatt hours of electricity each year.

Duke Power, headquartered in Charlotte, N.C., serves 500,000 customers in South Carolina's Upstate region. This large utility, which sells more

than 82,000 gigawatt hours of electricity annually in South Carolina, maintains about 12,500 miles of transmission lines and 52,000 miles of distribution lines in the state.

Progress Energy, like Duke Power, also is based in North Carolina. Progress Energy's headquarters is in Raleigh, N.C. and serves about 165,000 customers in the Pee Dee region of South Carolina. Progress Energy sells 7 billion kilowatt hours of electricity each year in South Carolina, and that electricity is sent to S.C. customers over its 1,900 miles of transmission lines and 8,123 miles of distribution lines.

Lockhart Power Company provides electric service to about 14,000 customers over its 90-mile transmission network. Lockhart maintains about 750 miles of distribution lines, sending 85 million kilowatt hours of electricity annually to its customers, and has the distinction of offering among the lowest electrical rates in South Carolina.

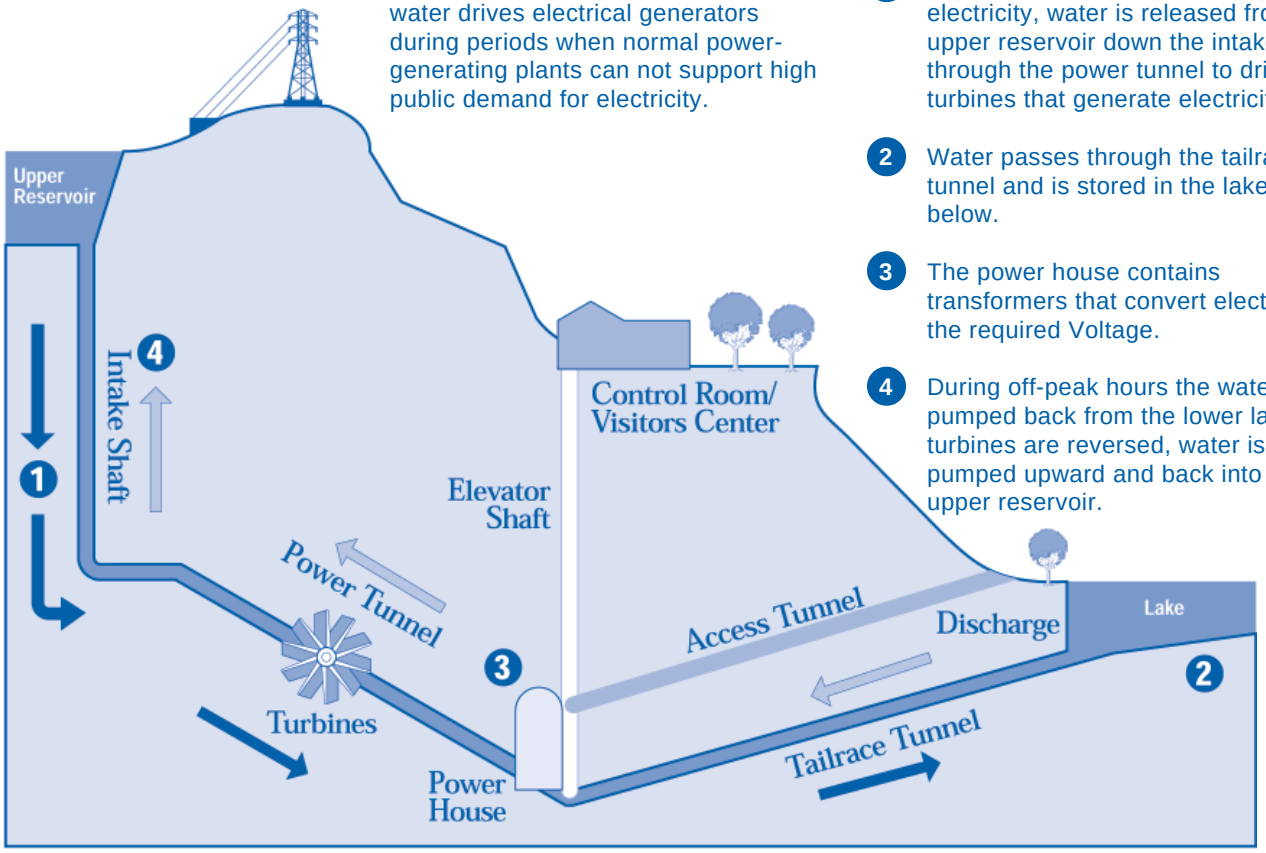
Santee Cooper: South Carolina's Public Utility

Santee Cooper is the state's public utility. It was created in the 1930s to bring electricity to rural areas. When it started, less than three percent of South Carolina's farms had electricity. A decade later, Santee Cooper supplied electricity to 91 percent of the farms in the state, mostly by providing wholesale power to South Carolina's electric cooperatives.

Santee Cooper, headquartered in Moncks Corner, now generates about 24 million megawatt hours of electricity each year. That electricity is sold to 135,000 retail customers and all of the state's 20 electric cooperatives. That electricity travels more than 4,424 miles of transmission lines and 2,222 miles of distribution lines.

Pumped-storage Power Plant: Recycling Water to Make Electricity

In pumped-storage power plants, falling water drives electrical generators during periods when normal power-generating plants can not support high public demand for electricity.



1. During hours of peak demand for electricity, water is released from the upper reservoir down the intake shaft through the power tunnel to drive turbines that generate electricity.
2. Water passes through the tailrace tunnel and is stored in the lake below.
3. The power house contains transformers that convert electricity to the required Voltage.
4. During off-peak hours the water is pumped back from the lower lake; turbines are reversed, water is pumped upward and back into the upper reservoir.

The Electric Cooperatives

About one-third of South Carolina's citizens get power from electric cooperatives (co-ops). Some co-ops are owned by the producers of the products or services they sell, but electric co-ops are owned by the users of the product (electricity). In other words, the consumers also are member-owners of the co-ops.

Electric cooperatives service more than 70 percent of the land area in South Carolina and serve consumers in every county in the state. Co-ops are located mostly in rural areas, small towns and suburbs of large towns. In order to reach rural locations, the cooperatives have to use a lot of power lines. In fact, the co-ops use and maintain more than 82,000 miles of distribution lines, more than all other S.C. utilities combined, in order to bring power to their more than 610,000 consumers.

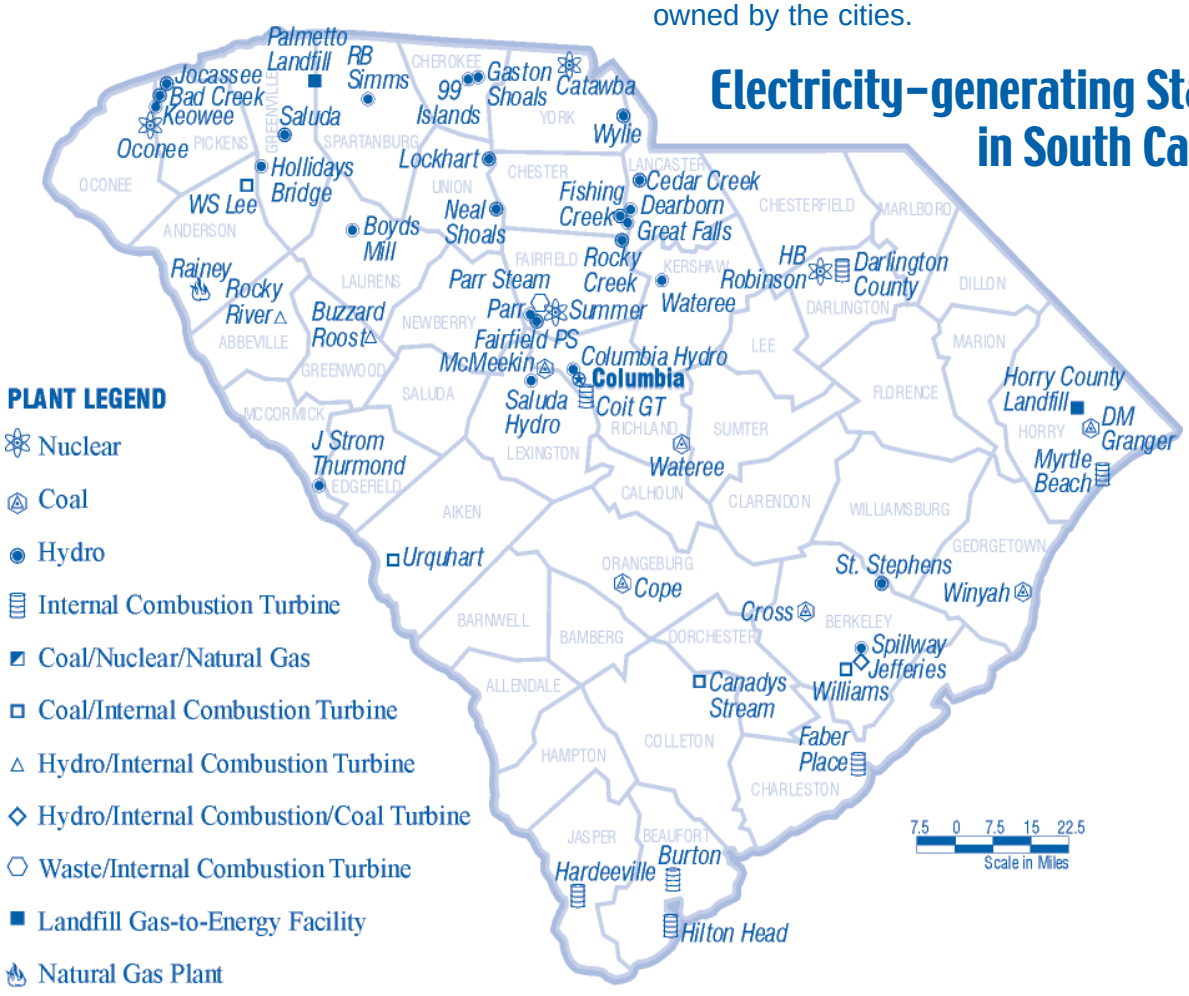
Most of the electricity sold by electric cooperatives is purchased wholesale from Santee Cooper. The co-ops operate on a not-for-profit basis, so all revenues above the cost of doing business are returned to the consumers in the form of credits.

Seventeen of South Carolina's 20 electric cooperatives are members of Touchstone Energy® – a national alliance of local, consumer-owned electric utilities committed to providing superior service and affordable rates to all customers, large and small.

South Carolina's Electric Cities

South Carolina also has 22 municipal electric utilities. These 22 "electric cities" provide electricity as a public service. This electricity is often referred to as "public power." Local governments purchase electricity from investor-owned utilities and Santee Cooper at wholesale prices and then distribute the power to customers at retail rates. Distribution systems are owned by the cities.

Electricity-generating Stations in South Carolina



Overall, South Carolina's electric cities sell more than 14 billion kilowatt hours of electricity to 288,000 customers each year. That electricity runs through 20,085 miles of distribution lines in order to reach its customers.

How We Use Electricity

The industrial sector uses a great deal of the electricity produced in South Carolina. About 41.5 percent of the electricity generated goes to operate factories and mills. Many of South Carolina's industrial users of electricity are scattered across the state, but the heaviest concentration of industrial facilities is in the Piedmont counties of Greenville, Spartanburg and Anderson.

One-third of the electricity produced in the state is used in private homes. Everything from the basic (refrigerators and lights) to the frivolous (bath towel warmers and game stations) runs on electricity.

More than 13 percent of South Carolina's electric energy goes to commercial customers. Again, the biggest users are in Greenville and Spartanburg counties. Charleston County is one of the biggest users of both commercial and residential electricity.

Conclusion

Electricity is an important part of South Carolina's energy past, present and future. Its utilities provide electricity to even the most rural areas. Modern technologies, including the use of nuclear fuel and pumped-storage, produce energy to meet the needs of all sectors of the state's economy.